Communications

New data on the non-indigenous gammarids in the Vistula Delta and the Vistula Lagoon

OCEANOLOGIA, 50 (3), 2008.
pp. 443–447.

KEYWORDS
Non-indigenous species
Southern Baltic
Vistula Delta
Vistula Lagoon
Poland

Justyna Surowiec
Aldona Dobrzycka-Krahel*

Institute of Oceanography,
University of Gdańsk,
al. Marszałka Piłsudskiego 46, PL–81–378 Gdynia, Poland

e-mail: aldona@ocean.ug.gda.pl

*corresponding author

Received 17 April 2008, revised 9 September 2008, accepted 15 September 2008.

Abstract

This communication reports on the occurrence of non-indigenous gammarid species of Ponto-Caspian and of North American origin – in the lower course of the River Vistula, in its Delta and in the Vistula Lagoon.

Long-term studies in the study areas have revealed a dramatic decline in the native gammarid species *Gammarus duebeni*, *G. zaddachi*, *G. salinus*, *G. oceanicus* and *G. varsoviensis*, the complete replacement of *Chaetogammarus ischnus* by other non-indigenous gammarids in lower course of the River Vistula, and the dominance of *G. tigrinus* in the Vistula Delta and Lagoon (Jażdżewski et al. 2004, Grabowski et al. 2006).

There are many factors, mostly anthropogenic, affecting the dispersal of alien Amphipoda. One of the most important to have contributed to the range expansion of many species is the removal of natural barriers between the various basins in Europe in the 19th and 20th centuries (Jażdżewski

1980). Most of the non-indigenous gammarids to have penetrated to the Baltic Sea did so from the River Volga, the Caspian Sea, the Black Sea and the Sea of Azov following the construction of canals, reservoirs and drainage systems and the consequent creation of water routes, so-called invasion corridors. Three such inland corridors are known, enabling non-native species to expand across Europe from the Ponto-Caspian basin to the Baltic Sea on the other hand, *G. tigrinus*, is an example of a non-native species that has been transported from the Atlantic coast of North America in the ballast waters of ships (Bij de Vaate et al. 2002, Jażdżewski et al. 2002).

The studies were of a quantitative character. The material for the authors' own studies was collected in April 2007 (the lower Vistula and its delta) and in June 2007 (the Vistula Lagoon). Animals were collected by two people with hand nets at each site for 45 min. In that way fairly large and representative samples could be collected.

Similarly, the materials for the studies in 1998–2000 were sampled using a hand net and a dredge, again by two people at each station for 45 min (Jażdżewski et al. 2004). The results of Żmudziński (1957), Jażdżewski (1975), Jażdżewski et al. (2004) and Grabowski et al. (2006) were compared to the analysis of faunal changes.

Long-term changes in the gammarid composition of the Vistula Lagoon have resulted in a similarly dramatic decline in native species. For example, *G. zaddachi* and *G. duebeni*, which were common in 1952–1956 (Żmudziński 1957, Jażdżewski 1975) and in 1970 (Jażdżewski 1975), have been replaced by the non-indigenous gammarids *Pontogammarus robustoides*, *Dikerogammarus haemobaphes*, *Obesogammarus crassus* and *G. tigrinus*.

G. zaddachi and *G. duebeni* were still present in 1998–2000, particularly in the northern part of the Vistula Lagoon (Jażdżewski et al. 2004), but by 2002 their proportions were quite low; in 2004 only *G. duebeni* remained at the study sites (Grabowski et al. 2006). Whereas *D. haemobaphes* was more abundant in the western part of the Vistula Lagoon, *P. robustoides* and *O. crassus* were present in its more saline areas.

The recent study has shown that now only non-indigenous species occur in the Vistula Lagoon, with *G. tigrinus* being dominant and *P. robustoides* present in smaller proportions in the Lagoon (Figure 1). 295 individuals were noted in samples taken from the Vistula Lagoon in 2007: 97.97% were *G. tigrinus* and 2.03% *P. robustoides*. Now a permanently dominant gammarid in the Vistula Lagoon, *G. tigrinus* tolerates a broad range of salinity – from freshwater to nearly marine conditions (Bousfield 1958). In Puck Bay it has also become the dominant gammarid (Szaniawska et al. 2003).

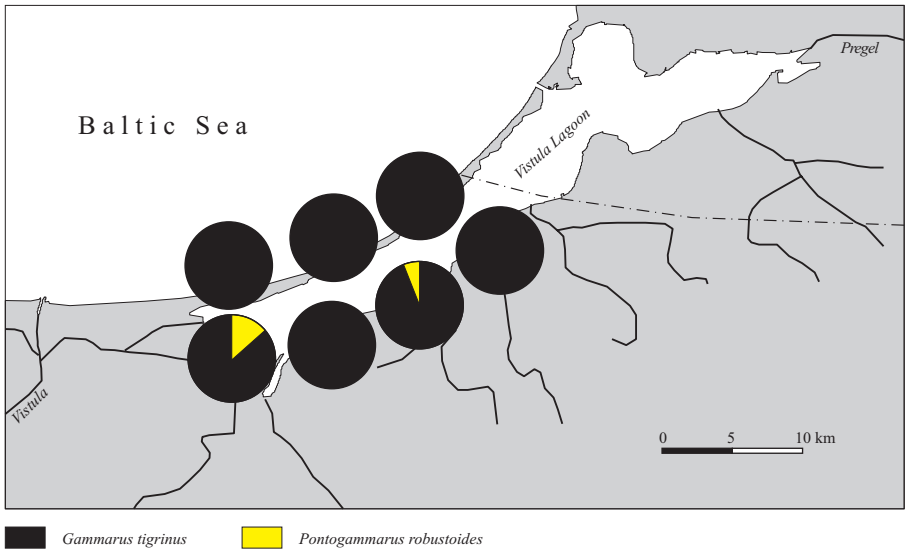

Figure 1. Species composition of gammarids in the Vistula Lagoon (2007)

Long-term trends in gammarid occurrence in the River Vistula show that *Chaetogammarus ischnus* (syn. *Echinogammarus ischnus*) of Ponto-Caspian origin – the first non-indigenous gammarid species to become dominant in the lower Vistula, in 1967–1971 (Jażdżewski 1975) – has since disappeared from the river. Later data indicate that this species was replaced by other non-indigenous species – *D. haemobaphes* and *P. robustoides* in 1998–2000; the present study (2007) has confirmed this trend.

In the Vistula Delta, the native species *G. duebeni*, *G. zaddachi*, *G. salinus* and *G. oceanicus*, common in 1967–1971 (Jażdżewski 1975) were mostly replaced in 1998–2000 (Jażdżewski et al. 2004) by the non-indigenous species *D. haemobaphes*, *P. robustoides* and *G. tigrinus*. Data from the present study (2007) show that only non-indigenous species were present at the study sites: *G. tigrinus*, *P. robustoides*, *D. haemobaphes* and *O. crassus*. 148 individuals were recorded in samples taken in 2007 from the Vistula Delta and the River Vistula: 64.86% were *P. robustoides*, 27.03% *G. tigrinus*, 4.73% *O. crassus* and 3.38% *D. haemobaphes* (Figure 2).

The inland waterways of Europe, climate change and global warming may have facilitated the dispersal of aquatic species from the rivers of the Ponto-Caspian basin (Dukes & Mooney 1999). Coupled with this is the ability of most amphipods to migrate long distances, a behavioural trait of theirs in both marine and freshwater ecosystems, which will have assisted the expansion of their natural range (Dedyu 1980).

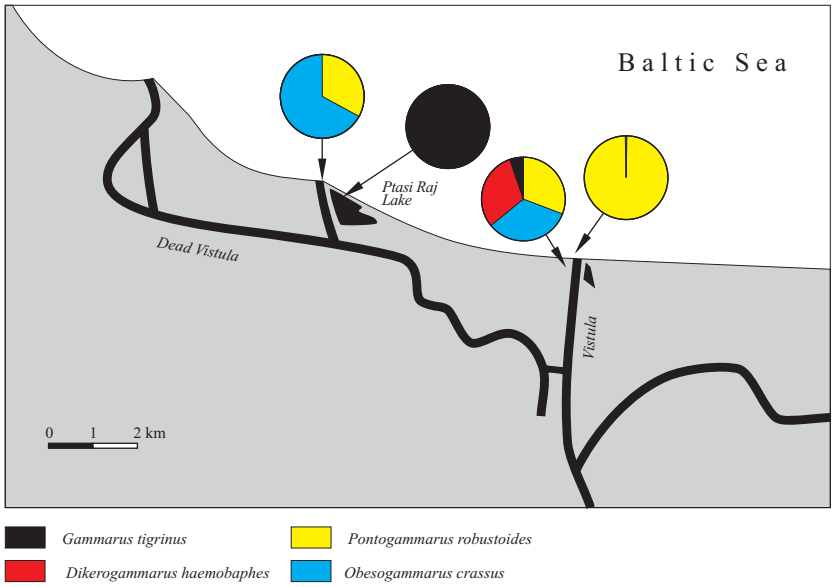

Figure 2. Species composition of gammarids in the Vistula Delta (2007)

Several factors are responsible for the successful invasion of new habitats by alien amphipods and their subsequent rapid increase in density: high fecundity, fast growth and juvenile maturation, a broad food spectrum, high genetic variability, and tolerance of a fairly broad range of salinity, temperature and oxygen concentration (Dedyu 1980, Wijnhoven et al. 2003, Grabowski et al. 2007).

Analysis of long-term changes shows that the appearance of non-native species has significantly altered the species composition. Such processes have been observed not only in the study areas but also in other Baltic lagoons (Olenin & Leppakoski 1999).

The retreat of native species is a serious problem in many places colonised by alien amphipods not only in Poland but right across Europe. The possible reasons behind this phenomenon include: (i) pollution of aquatic ecosystems to the extent that they are no longer tolerated by indigenous gammarids, (ii) predation pressure from the newcomers, and (iii) the greater reproductive capacity of the alien species (Grabowski et al. 2007).

References

Bij de Vaate A., Jażdżewski K., Ketelaars H. A. M., Gollash S., van der Velde G., 2002, *Geographical patterns in range extension of Ponto-Caspian*

macroinvertebrate species in Europe, Can. J. Fish. Aquat. Sci., 59 (7), 1159–1174.

Bousfield E., 1958, *Freshwater crustaceans of glaciated North America*, Can. Field Nat., 72 (2), 55–113.

Dedyu I. I., 1980, *Amphipods of the fresh and brackish waters of the South-West USSR*, Shtiintsa, Kishinev, 223 pp., (in Russian).

Dukes J. S., Mooney H. A., 1999, *Does global change increase the success of biological invaders?*, Trends Ecol. Evol., 14 (4), 135–139.

Grabowski M., Bącela K., Konopacka A., 2007, *How to be an invasive gammarid (Amphipioda: Gammaroidea) – comparison of life history traits*, Hydrobiologia, 590, 75–84.

Grabowski M., Konopacka A., Jażdżewski K., Janowska E., 2006, *Invasion of alien gammarid species and retreat of natives in the Vistula Lagoon (Baltic Sea, Poland)*, Helgoland Mar. Res., 60 (2), 90–97.

Jażdżewski K., 1975, *Morfologia, taksonomia i występowanie w Polsce kiełży z rodzajów Gammarus Fabr. i Chaetogammarus Mart. (Crustacea, Amphipoda)*, Acta Univ. Lodz., Łódź, 186 pp.

Jażdżewski K., 1980, *Range extension of some gammaridean species in European inland waters caused by human activity*, Crustaceana, Suppl. 6, 84–107.

Jażdżewski K., Konopacka A., Grabowski M., 2002, *Four Ponto-Caspian and one American gammarid species (Crustacea, Amphipoda) invading Polish waters*, Contrib. Zool., 71 (4), 115–122.

Jażdżewski K., Konopacka A., Grabowski M., 2004, *Recent drastic changes in the gammarid fauna (Crustacea, Amphipoda) of the Vistula river deltaic system in Poland caused by alien invaders*, Divers. Distrib., 10 (2), 81–87.

Olenin S., Leppakoski E., 1999, *Non-native animals in the Baltic Sea: alteration of benthic habitats in coastal inlets and lagoons*, Hydrobiologia, 393 (0), 233–243.

Szaniawska A., Lapucki T., Normant M., 2003, *The invasive amphipod Gammarus tigrinus Sexton, 1939, in Puck Bay*, Oceanologia, 45 (3), 507–510.

Wijnhoven S., van Riel M. C., van der Veelde G., 2003, *Exotic and indigenous freshwater gammarid species: physiological tolerance to water temperature in relation to ionic content of the water*, Aquat. Ecol., 37, 151–158.

Żmudziński L., 1957, *Zoobentos Zalewu Wiślanego*, Pr. Mor. Inst. Ryb., 9, 453–500.